Science Advisory Committee Meeting
Notes from 1-15-03 at Round Meadows, Catoctin Mountain Park

Introduction

Welcome and administrative details were discussed by Marcus Koenen.

Agenda

10:00 am	Welcome	M. Koenen
	Introductions	Participants
	Review of I & M Planning Process	S. Hood
	Review of Proposed Vital Signs	M. Koenen
11:00 am	Breakout Session – Each workgroup will meet to discuss vital signs and protocols related to subject.	

Workgroup Subject	Workgroup Facilitators
Remote Sensing/GIS	- Christina Wright
Vegetation Plots	- M. Milton/B. Steury
Water Resources	- Marian Norris/Jeff Runde

12:00 pm	Lunch	
12:30 pm	Breakout Session Continued	
2:00 pm	Break	
2:15 pm	Breakout Session Continues	
3:15 pm	Close of meeting	M. Koenen

Overview

The SAC is meeting to pick up where the July 02 monitoring workshop left off. Specifically, we will be reviewing the vital signs proposed during the workshop and determining how monitoring methods can be integrated to most efficiently and effectively monitor them.

As a result of the series of SAC meetings and the Monitoring Workshop in July, we identified broadly defined important natural resources, discussed threats to those resources, and identified ways to monitor them. Each of the workgroups focusing on those important resources prioritized potential vital signs. As a result, we have a list of **51 vital signs**.

We know that we **can not monitor all 51 vital signs**. We really need to further prioritize them but have found this quite a challenge; other networks are experiencing similar challenges. In November, we sent everyone a **list of criteria** that we were considering using to prioritize the vital signs. We assigned various point values to the vital signs based on each criterion, but we had a difficult time applying many of the criteria because of a number of unknowns. In addition, we received a number of comments back questioning the wisdom of using the criteria at this time.

Before we continued to prioritize, we decided that it would behoove us to see how different **vital signs could be combined**. That is to say, figure out how monitoring could be designed to monitor for multiple vital signs at the same time. To get us started on that, we reviewed the 51 vital signs and grouped them by how they might be monitored. As a result, we were able to group the 51 vital signs under **16 monitoring methods**. Today's meeting is designed to review the three monitoring methods which cover the most vital signs.

Purpose of Today's Meeting

Continue developing an integrated and comprehensive long-term Monitoring Plan for the National Capital Region of the National Park Service to provide information essential to preserving and enhancing the region's most important natural resources.

Expected Outcomes

As a result of the meeting, we will (1) determine if monitoring methods can effectively cover multiple vital signs, and (2) identify protocols to monitor grouped vital signs.

<u>Timeline</u>:

Sybil Hood provided a review of accomplishments and tasks that lie ahead.

Event	**Date**	**Product**
Formed BOD & SAC	FY01	BOD Charter
Interview Parks – priorities and current monitoring	FY01	Park Summaries
2nd SAC	FY02	9 Workgroups
3rd SAC	FY02	Resources, threats, ecological effects
4th SAC	FY02	Vital signs, overlap, protocols

Resource Managers	FY02	Network Goals
2nd BOD	FY02	Approve goals, plan for workshop
Monitoring Workshop	FY02	Peer review, vital signs, protocols, models, partnering
I & M Team	FY03	Phase I Monitoring Plan, Monitoring Workshop Report
SAC	TODAY	Review proposed vital signs
SAC	FY03	Select vital signs
I & M Team	FY03	Phase II Monitoring Plan
I & M Team	FY04	Phase III Monitoring Plan
BOD	FY05	Approve final plan
WASO	FY05	Approve final plan

Workgroup Tasks

In order to meet the expected outcomes, each Breakout Session will work on the following:

- review the vital signs that we grouped together. Add other vital signs to the groups as appropriate, and remove any vital signs that obviously need to be monitored in other ways.

- identify the key pieces of information that are needed to address each of the vital signs

- identify specific methods to monitor vital signs - if time allows, consider who can help us develop the protocols

<Workgroups Meet>

I. Remote Sensing

Participants: Dale Nisbet (NPS – HAFE), Tammy Stidham (NPS – HQ), Toni Orcutt (NPS – CHOH), Brian Carlstrom (NPS – PRWI), Marie Frias (NPS – CHOH) Marcus Koenen (NPS – NCR).

Facilitator: Christina Wright (NPS – NCR),

Handouts: See Appendix 1.

Remote Sensing Workgroup

The objectives of the remote sensing working group were to

(1) Go through the vital signs and monitoring objectives, developed at previous SAC meetings, and decide which ones could be accomplished using remote sensing techniques.

(2) Go through those objectives, one at a time, and define/describe details about the imagery needed to address the monitoring objectives (including both preferred and acceptable options).

(3) Decide which of the monitoring objectives may be met using the same set(s) of imagery – even though the analysis techniques may be different.

(4) Discuss if NCR has that imagery, who else might have that imagery, cost, frequency of purchase, etc.

Following this description is a list of monitoring objectives and vital signs that applied to remote sensing and the discussion points described above.

1) Obtain fragmentation indices (at various scales) using annual satellite imagery and/or aerial photography every 5 years. Develop and maintain a georeferenced GIS database of fragmenting features within each park (roads, trails etc.). #25

Vital Signs:

- Ratio of edge to interior
- Patch distribution and composition in vegetated versus urban areas
- Proximity of patches to each other and to development or other fragmenting feature

It was decided that this monitoring objective and potential vital signs could be addressed by remote sensing.

Preferred imagery: Satellite Photography - IKONOS
Panchromatic OK (color not necessary)
1 m resolution
Cost estimate ~ $10,000 for the region

Sources: USFS has IKONOS for DC and some of the surrounding area
NPS has IKONOS for POGO
USGS may have some IKONOS for the region
EPA/Chesapeake Bay Program may also have some of this for the region

Other Imagery: Aerial Photos (on a county by county basis) may also be used
Previous cost estimates run ~ $1200-2400 per county
VA has flown the whole state and NPS/NCR is hoping to buy this in April

2) Monitor the number of forest interior patches of greater than or equal to 5000 ha within the lower Chesapeake Bay Watershed (LBCW) for 5 years. #26

Vital Signs:
- Amount of forest interior habitat
- Size/edge index
- Distance between habitats

It was decided that this monitoring objective and potential vital signs could be addressed by remote sensing – using the same imagery as in number 1, above.

Preferred imagery: Satellite Photography - IKONOS
Panchromatic OK (color not necessary)
1 m resolution
Cost estimate ~ $10,000 for the region

Sources: USFS has IKONOS for DC and some of the surrounding area
NPS has IKONOS for POGO
USGS may have some IKONOS for the region
EPA/Chesapeake Bay Program may also have some of this for the region

Other Imagery: Aerial Photos (on a county by county basis) may also be used
Previous cost estimates run ~ $1200-2400 per county
VA has flown the whole state and NPS/NCR is hoping to buy this in April

3) Monitor the percent of protected, number, and contiguity of green and blue space within the lower Chesapeake Bay Watershed (LCBW) for 5 years. #27

Vital Signs:
- Connectivity of habitat of interest
- Number of breaks in corridor

It was decided that this monitoring objective and potential vital signs could be addressed by remote sensing, using the same imagery as numbers 1 and 2 above.

Preferred imagery: Satellite Photography - IKONOS
Panchromatic OK (color not necessary)
1 m resolution
Cost estimate ~ $10,000 for the region

Sources: USFS has IKONOS for DC and some of the surrounding area
NPS has IKONOS for POGO
USGS may have some IKONOS for the region

EPA/Chesapeake Bay Program may also have some of this for the region

Other Imagery: Aerial Photos (on a county by county basis) may also be used
Previous cost estimates run ~ $1200-2400 per county
VA has flown the whole state and NPS/NCR is hoping to buy this in April

4) Monitor the percent cover of forest habitat types within the lower Chesapeake Bay Watershed (LCBW) for 5 years. #28

Vital Signs:

- Forest habitat types
- Bird Community Index - *Deleted with respect to Remote Sensing*

It was decided that forest habitat types could be addressed by remote sensing techniques, but that Bird Community Index could not. Developing a Bird Community Index would require on the ground surveys. Because the area of interest is the Lower Chesapeake Bay Watershed (LCBW), the Remote Sensing group assumed that forest habitat types meant identification to the formation level or even coarser (eg. Land use type).

Preferred Imagery: Aerial Photography, Color Infrared
Leaf on and Leaf Off (Spring, emergence and Fall, peak color)
Cost – Prohibitively high for all of the LCBW – 7 figures

Other Imagery: Satellite Photography
Multispectral or Color Infrared
1 m resolution
Cost – Around $10,000 for CIR, more for multispectral

MRLC – Multi Resolution Land Characteristics Consortium
Source: USGS or EPA
30 m resolution at the Land Use Level
Cost – Basically free

5) Use mapping or survey methods to track shoreline change and depositional patterns. #29

Vital Signs:

- Inundation of wetlands
- Erosion and sedimentation processes

It was decided that this monitoring objective and potential vital signs could be addressed by remote sensing.

Preferred Imagery: LIDAR
Cost – Prohibitively high, 7 figures

Other Imagery: Aerial Photography
Panchromatic is OK
1 m resolution, (1:12,000 scale)
Frequency – every 2-5 years
Dyke Marsh photography cost about $3000 for 10 years of photos

Comments: Digitize shoreline from photos taken with the tide at the same level
Use historic photos as a baseline
Select specific areas to concentrate on and monitor (areas of interest to the parks)

Source: The Army Corps of Engineers does a lot with shoreline change

6) Maintain GIS layer of internal development and maintained/landscaped areas (updated annually). Characterize vegetation lost (gained) disturbed as a result. #30

Vital Signs:
- Characterize vegetation losses or gains
- Percent loss of native vegetation *(Native Vegetation aspect deleted for RS)*
- Percent disturbance/loss of topsoil due to development *(Topsoil loss deleted for RS)*

It was decided that remote sensing could address areas of internal development, % disturbed, or developed versus non-developed areas. Native vegetation, loss of topsoil were deleted with respect to remote sensing techniques. This is basically the opposite analysis from number 4 (above) and would therefore use the same imagery.

Preferred Imagery: Aerial Photography, Color Infrared
Leaf on and Leaf Off (Spring, emergence and Fall, peak color)
Cost – Prohibitively high for all of the LCBW – 7 figures

Other Imagery: Satellite Photography
Multispectral or Color Infrared
1 m resolution
Cost – Around $10,000 for CIR, more for multispectral

MRLC – Multi Resolution Land Characteristics Consortium
Source: USGS or EPA
30 m resolution at the Land Use Level
Cost – Basically free

7) Monitor status and trends of forest interior birds to determine the quality of forest interior habitat within the lower Chesapeake Bay Watershed for 5 years. #31

Vital Signs:
- Bird Community Index

This was entirely deleted with respect to remote sensing solutions

8) Maintain GIS layer of (near) external development (update annually). Identify internal areas likely to be affected by changes in hydrology and weed sources. Monitor vegetation composition changes. #32

Vital Signs:
- Vegetation composition changes as a function of distance

It was decided that this is really more of a research proposal than a monitoring project and thus should be addressed through a NRPP/SCC proposal. Thus it was not discussed here.

9) Monitor percentage and distribution of the targeted species suitable habitat within the lower Chesapeake Bay Watershed for 5 years. #33

Vital Signs:
- Change in % of any species specific habitat *(already covered in number 4)*
- Bird community index *(deleted for Remote Sensing)*
- Percentage of impervious surface

It was decided that impervious surfaces could be determined using remote sensing techniques. Change in habitat was already addressed in number 4 and was thus deleted here. Bird community index cannot be done by Remote Sensing and was also deleted here.

Note: Monitoring goals and objectives related to impervious surfaces would need to be written.

Preferred Imagery: Satellite Photos
Multispectral Imagery
10 m resolution
Cost – not known by group
Frequency – would depend on the question being asked

Other Imagery: MRLC may identify areas of impervious surface

Sources: The Smithsonian did a study of impervious surfaces by remote sensing. Tammy will check on type of imagery, cost, name of person heading up the project.

10) Estimate the number of egg masses (and mean size) in vegetation types susceptible to gypsy moth defoliation. #34

Vital Signs:

- Acres defoliated
- Egg mass density, mean egg mass size *(deleted for RS)*
- Vegetation composition under defoliated areas *(deleted for RS)*

Remote sensing could identify areas defoliated by gypsy moth – while on the ground surveys would be needed to note egg mass density and size, as well as vegetation composition under defoliated areas (thus these were deleted from the remote sensing approach).

Note: Monitoring goals and objectives would need to be rewritten for a remote sensing project.

Preferred Imagery: Aerial Photos
1 m resolution
Panchromatic is OK
Taken annually at peak infestation time

Other Techniques: USFS does this by overflights and marking areas on a topo sheet
USPP could do this with overflights and GPS
This could be linked to the vegetation map for rough veg. composition
Some gypsy moth surveys have noted veg. composition in the past

11) Measure loss of soil, growth of gulleys, changes in stream banks… Track sedimentation history and impacts (including streams and ponds, hill slopes and gulleys). #35

Vital Signs:

- Changes in topography
- Sediment loading and deposition *(deleted from RS group)*
- Shoreline change
- Wetland extent and condition

It was decided that changes in topography, shoreline change, and wetland extent (but not condition) could be monitored by remote sensing. Sediment loading and deposition and sedimentation history would be best monitored locally and thus were not considered here. Very similar to number 5 above.

Note: The monitoring goals and objectives would need to be rewritten to reflect a remote sensing project.

Preferred Imagery: LIDAR
Cost – prohibitively high

Other Imagery: Aerial Photography
Panchromatic is OK
1 m resolution, (1:12,000 scale)
Frequency – every 2-5 years
Dyke Marsh photography cost about $3000 for 10 years of photos

Comments: Digitize shoreline from photos taken with the tide at the same level
Use historic photos as a baseline
Select specific areas to concentrate on and monitor (areas of interest to the parks)

Source: The Army Corps of Engineers does a lot with shoreline change

12) Monitor the number of physical structures viewable from park units and other green space within the Lower Chesapeake Bay Watershed for 5 years. #38

Vital Signs:
- Viewshed analysis program

The remote sensing group thought that this would be a two-step project, not all of which would be addressed by remote sensing. In addition, this should be park specific, not done for the entire LCBW. Step 1: determine park specific, critical viewsheds – which would not be a remote sensing project but done by the parks, locally. Step 2: Take photopoints and develop a GIS-based viewshed model of the site for monitoring.

Preferred Imagery: Aerial Photography
1 m resolution
Color would be nice, Panchromatic OK
Frequency – at least every 2 years (or different depending on the site)

Other Layers: DEM

13) Estimate the area (length and width) of social trail impacts within the highest visitor use areas at the 11 parks, every 3 years. #39

Vital Signs:

- Number of social trail extent and condition of existing trails
- Number of visitors per year *(not a Remote Sensing application)*

It was decided that this could be done using remote sensing. Note: There are more cost effective ways of assessing social trails and their extent than by remote sensing, however other methods may take longer.

Preferred Imagery: Aerial Photos, true color
Leaf Off
Better than 1 m resolution
Cost – not known by group
Frequency – depends on the site - Is there resource damage? Safety issue?

Other ideas: Walk the park and GPS social trails
Use historic photos and look at changes over time

14) RTE Communities #36

Not discussed by group at this time – need more information from RTE group.

15) RTE Species #37

Not discussed by group at this time – need more information from RTE group.

Following the above discussion, the remote sensing group determined which monitoring objectives could be met by using the same set of imagery (even if analysis techniques would be different). We came up with the following groupings:

A) Satellite Photos, 1 m resolution

Vital Signs: 1, 2, 3, and 4 (maybe)

B) Aerial Photos, Color Infrared

Vital Signs: 6, 10, 4 (preferred), 5 (maybe), 9 (maybe), 11 (maybe), 12 (maybe)

C) LIDAR

Vital Signs: 5, 11

D) Aerial Photos, Panchromatic

Vital Signs: 5, 10, 11, 12 (maybe)

E) Satellite Photos, Multispectral

Vital Signs: 9

F) Aerial Photos, True Color

Vital Signs: 12, 13

From the above groupings, it can be seen that all remote sensing applications addressed by this group could be accomplished through the purchase of satellite photos (1m) and aerial photos (CIR) – except for number 13 that deals with social trails. However, by using methods A and B (above), not all projects would have access to their preferred imagery types – listed earlier in this document (numbers 1-15). The remote sensing group ended the meeting by discussing satellite photos (1m) and aerial photos (CIR).

<u>Satellite photos – 1m</u>

- NPS/NCR does not have any of these
- NPS/NCR does have some old 10 or 30 m SPOT photos
- See IKONOS webpage for price, probably in $10,000 – 50,000 range
- Ideal frequency – every 2 years
- For LCBW projects: USFS does a lot with fragmentation and may have imagery and EPA/Chesapeake Bay may also have this information
- Analyses would be contracted out

<u>Aerial Photos – Color Infrared</u>

- NPS/NCR will have some of these from Veg Mapping
- Ideal frequency would be twice a year (leaf on and off), every 2 years
- Cost at 1m would be too high for this frequency
- Look at playing with resolution/scale to bring price into reasonable levels
- Partnering: GIS, planning, lands, park police etc. should all have an interest in obtaining these photos and thus perhaps cost sharing would be a viable method of obtaining this information on a regular basis.

Again, analyses would be contracted out

Vegetation Monitoring

Participants: Sue Salmons (NPS – ROCR), Diane Pavek (NPS – NCR), Brent Steury (NPS – NACE), Jim Sherald (NPS – NCR), George Taylor (George Mason University), Doug Samson (TNC – MD), Kent Schwarzkopf (NPS – APPA), Diane Ingram (NPS – CHOH), Andrew Banasik (NPS – EPMT), Joe Calzarette (NPS – ANTI). Leland Tarnay (NPS- NCR), Chipp Scott (USDA FS - FIA), Chris Lea (NPS – ASSA), Sybil Hood (NPS – NCR).

Facilitator: Mikaila Milton (NPS – NCR),

Handouts: See Appendix 2.

Discussion: The group was presented with a table listing all of the vital signs grouped under vegetation plot monitoring. The group discussed items presented in the "Key Information" and "Monitoring Methods" column.

No	**VITAL SIGN** *vital sign from workshop*	**KEY INFORMATION** *monitoring goals from workshop*	**MONITORING METHODS** *monitoring objectives from workshop*
1	*Ratio of exotics to natives, species richness, percent cover of exotics and natives, density/stem counts.* **threat non native plants**	*Determine the ratio of native to exotics.* -how extensive they are (cover); -aggressiveness (displacement of natives); -location (in relation to development-in relation to vulnerability of habitat-in relation to community); -early detection of new invasives (catch early)	*Estimate the species cover in 11 park units yearly until 2008 in 1% of naturally established vegetative areas.* * - percent cover of native and non-native species (stratify for habitat); survey and count (could note insect damage while doing); * - overall forest health (for example canopy gaps); + - remote imagery; * - regeneration
2	*Percent loss of native vegetation; percent disturbance/loss of topsoil due to development.* **Internal development**	*Identify loss of native vegetation.* - percent loss; - effect on vegetation; - edge added with each new development (trails, buildings, etc.)	*Maintain GIS layer of internal development and maintained/landscaped areas (update annually). Characterize vegetation lost (gained) disturbed as a result (see fragmentation).* + - remote sensing; < - change in vegetation with distance from disturbance (small scale transects)

No	VITAL SIGN *vital sign from workshop*	KEY INFORMATION *monitoring goals from workshop*	MONITORING METHODS *monitoring objectives from workshop*
3	*Ratio of edge to interior, patch size, distribution, composition (veg vs urban), proximity (of patches to each other and to development or other fragmenting feature)* **Threat fragmentation**	*Determine the ratio of edge to interior patch size.* - amount; - effects on vegetation	*- develop and maintain georeferenced GIS database of fragmenting features within each park (roads, trails, etc.); +* - remote sensing
4	*Vegetation composition change as a function of distance* **threat external development**	*Determine vegetation composition change as a function of distance from development.* - identify potentially affected areas; - see above; - hydrologic changes as they affect vegetation	*Maintain GIS layer of (near) external development (update annually). Identify internal areas likely to be affected by changes in hydrology and weed sources. Monitor vegetation composition changes. (See fragmentation.)* - GIS layer (see above); < - change in vegetation; * - general forest health, including regeneration and age parameters
5	Habitat quality (We assumed that this is what the landscape group was getting at.) **change in % of any species specific habitat; bird community index; percentage of impervious surface (vital sign from landscape group)** We decided that this vital sign was the same as the next one"forest habitat types-bird community index" and did not answer this one separately.	*Monitor species specific natural habitat.* - plant communities present and relative abundance; - change in plant communities; - species composition and structure **(monitoring goal of landscape group)**	*Monitor percentage and distribution of the targeted species suitable habitat within the Lower Chesapeake Bay Watershed for 5 years.* - vegetation mapping for inventory; * permanent plots **(monitoring objectives of the landscape group)**

No	**VITAL SIGN** *vital sign from workshop*	**KEY INFORMATION** *monitoring goals from workshop*	**MONITORING METHODS** *monitoring objectives from workshop*
6	Vegetative regeneration *Seedling regeneration; distribution of species preferred by deer vs. species not preferred by deer; numbers of seedlings and saplings by height class; percent of area with adequate regeneration by size class distribution.* **Threat white-tailed deer**	*Identify impact of deer on forest regeneration.* - Seedling regeneration; distribution of species preferred by deer vs. species not preferred by deer; numbers of seedlings and saplings by height class; percent of area with adequate regeneration by size class distribution.	*Show relationship between seedling regeneration and deer population size.* - exclosures; * - browse surveys
7	- downed trees -exposed roots (cumulative) *number of downed trees and exposed roots; flood plain species composition* **threat stream bank and channel erosion**	*Determine number of downed trees and exposed roots.* - loss of herbaceous vegetation; - change in species composition	*Determine the number of fallen trees and exposed roots annually on vertical bank slopes and the change of species composition every 5 years in floodplain habitat.* - measurement of exposed roots (centimeters exposed); - other groups such as water are dealing with this and may have better measurements such as stream width and incision; < - transect away from stream
8	Invasive invertebrate species **(vital sign from the invertebrate group—though it sounds more like a threat)** (Jim Sherald suggested adding pathogens to our list of threats.)	*prevent invasion of invertebrate species* **(monitoring goal of the invertebrate group)** - cannot be monitored adequately solely by vegetation monitoring	*Identify potential invertebrate species. Implement monitoring to identify potential invertebrates in order to detect and prevent spread in a timely manner.* **(monitoring objective of the invertebrate group)** - roving transects in different habitats (in conjunction with surveying for exotic plants); Note: this will probably not be sufficient by itself for catching early infestations.

No	VITAL SIGN *vital sign from workshop*	KEY INFORMATION *monitoring goals from workshop*	MONITORING METHODS *monitoring objectives from workshop*
9	Ozone sensitive species **threat - air pollution from air group**	*Monitor ambient ozone concentrations and trends that affect human health for employees and the public and assess impacts to terrestrial ecosystems.* **(monitoring goals of the air group)** - visible damage to sensitive species (visible leaf damage) done by FIA	*Communicate risk of ozone to human health for employees and the public and assess impacts to terrestrial ecosystems.* **(monitoring objectives of air group)** - purposeful sampling (non-random); * genomic tools from Germany (suggested by George Taylor) (are not limited to sensitive species—add to permanent plots)
10	**Lichens** (from the vegetation group)	*Monitor ambient ozone concentrations and trends that affect human health and terrestrial ecosystems.* **Monitoring goals of the vegetation group** **(lichens)** - element analysis (after baseline-nitrogen, heavy metals); - sensitive species changes over time (after baseline of species composition)	*Establish long-term monitoring plot for lichens at a range of sites. Monitor lichen cover and composition and correlate with regional O3, NxOx and SxOx levels. Monitor every 5 years to establish trends. Monitor O3 damage to vascular plants.* **Monitoring objectives of the vegetation group.** **(lichens)** * - plots around target species; (could be a subset of the larger permanent plots)
11	R, T & E *RT &E Species/ Communities*	*Monitor priority sites.* - location; - numbers over time; - reproduction; - demographics	- depends on species; - monitor suitable habitat; Note: it was mentioned that it will be difficult to come up with one monitoring plan that would cover all RT&E species and communities.

* equals permanent plots
< equals transects
\+ equals remote imagery

Summary: A review of vital signs related to vegetation monitoring suggested that most vital signs can be monitored through a combination of widespread permanent plots (vital sign numbers 1, 4, 6, 9, and 10) supported with remote sensing data (vital sign numbers 1, 3, and 4), and limited or local transects (vital sign numbers 2, 4, and 7).

The long-term vegetation monitoring plots would have to provide:

- Percent cover by species and height class, native and non-native (everything) individual species
- Presence and absence
- Tree regeneration by species and size class
- Woody regeneration using a densiometer or similar tool to get at thinning, canopy cover, overall forest health
- Coarse woody debris, standing dead, snags, (general forest health)
- FIA has around 140 variables to measure forest health

The transects would have to include:

- Larger scale?

Remote sensing would have to include:

- Internal development

Next Steps: Determine if remote sensing data can be combined with remote sensing data that may be collected by Remote Sensing breakout session. Determine if water quality monitoring will also include habitat monitoring including erosion. Vital signs associated with RTE species and communities is being developed seperately.

Water Resources

Participants: Jim Voigt (NPS – CATO), Lindsay McClelland (NPS – GRD), Ed Wenschoff (NPS – ANTI), Ray Chaput (NPS – Volunteer), Jeff Runde (NPS – NCR), Jennifer Lee (NPS – PRWI), Craig Snyder (USGS – Leetown), Bill Lellis (CESU), Gopaul Noojibal (NPS – NACC), Michelle Clements (NPS – ANTI), Pat Bradley (EPA – MAIA), Tina Orcutt (NPS – CHOH), Diane Ingram (NPS – CHOH),

Facilitator: Marian Norris (NPS – NCR),

Handouts: See Appendix 3.

We quickly reviewed the vital signs that could be covered by information collected during a site visit through sample collection or direct observations.

We listed the main pieces of information needed to determine each of the vital signs. We also noted when other data such as remote sensing would be required to complete the information. Each piece of information corresponded to an existing method.

A. Changes in topography, sediment loading and deposition, shoreline change, wetland extent and condition

Monitoring Goal:
Use survey and analysis methods to evaluate changes in topography, sediment loading, and flow rates

Monitoring Objective:
(1) Measure loss of soil, growth of gullies, changes in stream banks.
(2) track sedimentation history, effects, and impacts (including streams and ponds, hill slopes and gullies)

Needed Information:

<u>Stream profile</u> including	Channel characterization
	Mean depth
	Channel cross-section
	Particle size of bedload
	Wetland delineation
	Wetland function
	Rosgen analysis

Monitoring Method

Physical Habitat Index provides information on particle size of bedload and wetland condition, channel cross section, and mean depth.

Shallow coring can be used to determine site history, sediments, particle size of bedload, .

Aerial photographs can help delineate wetlands.

Transects are needed at flow measurement sites.

Frequency: regularly or after a major event such as a storm or development project

Existing Sources: USGS – have methods to look at back 400 years. They also have elevation and remote sensing data to look at topography over past 100 years.

B. Inundation of wetlands, erosion and sedimentation processes

Monitoring goal:
Use mapping or survey methods to track shoreline change and depositional patterns

Monitoring Objective:
(1) Measure shoreline change using aerial photos, LIDAR or other survey methodologies; correlate to development.
(2) Understand long-term flood histories.
(3) Determine if tidal influence on Dyke Marsh, Kingman Lake, Kenilworth Gardens, etc., is adequate for the success of restoration

Needed Information:

<u>Mapping</u> – annually of wetland elevation, edge, episodic after big storm, landuse change, at least annually.

Relate <u>wetland water level</u> to <u>ground and surface water levels</u>

<u>Changes in sedimentation</u>

<u>Condition of wetland</u> - changes in wetland plant species.

<u>Analysis of sediment cores -</u> including an analysis of historical sediment records.

Monitoring Method

For mapping – use transects and GPS to measure changes in wetland elevation and wetland edges.

Water levels can be measured with meter sticks for surface waters and wells for groundwater.

Sedimentation can be measured using sediment plates, total suspended solids, and light penetration in water column. *Frequency:* episodic, storm water event sampling

Condition of wetlands can be measured using Physical Habitat Index as in 1(above).

Sediment Coring should be done to provide historic context.

Existing Sources: This information could tie into shoreline change models.
Info available from other sources:

- Penn State shoreline inundation models (see EPA/MAIA) - they have an additional grant, ask them to study our area,
- Charlie Roman at University of Rhode Island is working on sea level in marshes
- See also www.climatescience.gov for mapping, modeling, monitoring, funding

C. Physical Habitat Index

Monitoring Goal:
Is parameter or metric X varying within pristine or un-impacted (desired condition) ranges during various natural conditions? (Irwin 2002)

Information Needed:

Variety of parameters collected to define condition for Physical Habitat.

Monitoring Methods

PHI will be based on existing indices used by Maryland, Virginia, EPA, and USGS.

Frequency: Once at base flow / per year, and at MBSS sampling times
Index to include Stream Profile, embeddedness as a surrogate for bedload particle size, and Transect/delineation of Wetlands measurements from Changes in Topography… above

D. Nutrients

Monitoring Goal: Use an input/output approach to understand nutrient and contaminant cycling in the ecosystem (geology)**.** Is parameter or metric X varying within pristine or un-impacted ranges (desired condition) during various natural conditions? (Irwin 2002)

Monitoring Objective:
(1) Measuring nutrient inputs from sources pertinent to each park unit.
(2) Measuring contaminant inputs from sources pertinent to each park unit.
(3) Tie information from numbers 1 and 2 to the hydrologic cycle, flood history, flood effects, and flood impacts.

Information Needed:

Concentrations of P (storm events) and nitrates, nitrites, ammonia (hi-lo min),
pH
acid neutralizing capacity (ANC)
storm water flow
flood frequency
stream morphology
changes in sedimentation
storm water event sampling
total suspended solids
light penetration in water column
sedimentation coring (deep cores – research; shallow cores - monitoring)
shoreline change (use of Pope's Creek as a reference area)
condition of wetland - changes in wetland plant species
algal growth
light penetration

Monitoring Methods:

HACH test kits

Frequency: episodic storm events are important in NH4, total/ortho/reactive P; otherwise once per month

Existing information: Air quality monitoring stations that also capture atmospheric deposition (National Atmospheric Deposition Program). Also, studies at Fourmile run beginning in the 1950's (pre-urbanization) looked at effects of urbanization

E. Specialized Water Quality Parameters

Monitoring Goal:
Is parameter or metric X varying within pristine or un-impacted ranges (desired condition) during various natural conditions.

Monitoring Objective:

Needed Information:
Pesticides
Industrial chemicals
Landfill leachate: Hg
PCB's
Bacteria (sewage and septics)
Aluminum
Lead
Arsenic
Petroleum

Note the following two are also desirable:
Pharmaceuticals
Endocrine disrupters

Sewage treatment plants should be monitoring effluent to provide contaminant source information.

Monitoring Methods

Hach test kits, for specific contaminants, in consideration of meeting Clean Water Act standards. These can not, however, test for pharmaceuticals and endocrine disrupters.

Existing data sources: USGS is sampling for air deposition (eg CATO and SHEN Hg&N
CATO received $36 K to implement short-term specialized water monitoring
Air models can provide predictive information
States do some limited monitoring

F. Groundwater Level

Monitoring goal:
Measure groundwater changes over time

Monitoring Objective:
Evaluate changes and cause of groundwater changes

Information Needed:
Groundwater levels
Flow/volume of seeps and springs over time

Frequency: perhaps monthly but check USGS guidance

Monitoring Methods
Install monitoring wells following USGS-NAWQA permanently referenced well protocols. Long-term data loggers are expensive. Depending on where the well is sited, well installation can be prohibitively expensive.

Existing data sources: There are wells outside of parks and one could extrapolate to parklands instead of setting up new wells.

See also: Stream Study EPA-MAIA wells in streams; USGS-NAWQA; biogeostatistical models sites; old wells in parks?

G. Changes in Groundwater chemistry

Monitoring goal:
Use an input/ouput approach to understand nutrient and contaminant cycling in the ecosystem

Monitoring Objective:
(1) measuring nutrient inputs from sources pertinent to each park unit,
(2) measuring contaminant inputs from sources pertinent to each park unit
(3) tie information from numbers 1 & 2 to the hydrologic cycle, flood history, flood effects, and flood impacts

Information Needed:
Combine nutrient monitoring and specialized water quality parameters with groundwater monitoring wells. A model can be developed using: Vulnerability mapping, mass balance air, surface, groundwater in/out.

Monitoring Methods
Hach test kits for Nutrients and other Specialized Water Quality Parameters (see above) and wells.

Monitoring Wells – see F above.

Existing data: Lithogeochemistry mapping data available through USGS BRD Partner.

H. Core Water Parameters

Monitoring Goal:
Is parameter or metric X varying within pristine or un-impacted (desired condition) ranges during various natural conditions?

Monitoring Objective:

Information Type and Source:
Temperature
DO
pH
conductivity
flow – meter, gauging station to determine flashiness, major episodes, hydrograph
ANC – Hach test kit everywhere first year, trouble spots once/year after

Monitoring Method
Use a multiprobe meter (Hydrolab). Flow measured separately with a flow meter. This would be monitored at the same time as HACH Kit.

Frequency: Measure monthly at least and whenever take other samples

Existing data sources: USGS, volunteer monitoring groups, state and local monitoring

I. Fish Index

Monitoring Goal:
Is parameter or metric X varying within pristine or un-impacted (desired condition) ranges during various natural conditions?

Monitoring Objective:

Information Needed and Potential Source:
The combined diversity and sensitivity index is calculated by numbers and types of fish species (and/or family).

Monitoring Methods
Electro-shocking - MBSS, EMAP, and counties have comparable methods (Fairfax and COG use EPA RBP)
Frequency: Annually at most, better biennial in summer (July – October)

J. Macroinvertebrates Index

Monitoring goal:
Is parameter or metric X varying within pristine or un-impacted (desired condition) ranges during various natural conditions.

Monitoring Objective:

Information Needed and Potential Source:
The combined diversity and sensitivity index is calculated by numbers and types of invertebrates species (and/or family).

Monitoring Method
Collection and ID – MBSS method.

Frequency: once per year in spring, all sites over 2 months

Discussion Combining Vital Signs

Following the above discussion, the water methods group determined which monitoring objectives could be met by using the same type of observations (even if analysis techniques would be different). We came up with the following groupings (Letters in Parentheses refer to respective Vital Signs listed above):

1. Physical Habitat Index including (A, B, C):

2. Shallow coring to determine site history, sediments, and particle size of bedload (A)

3. Wetland functioning/condition measured yearly and episodically (A, B)

4. Mapping of elevation, edge, sediment budget (B)

5. Sediment plates (B)

6. Surface water level (B, H)

7. Monitoring wells (B, E, F)

8. HACH kits (C, D, F)

9. multiprobes (C, F, H)

10. Fish IBI (I)

11. Invertebrate IBI (J)

12. Available Information / Existing Programs: The following vital signs (in parentheses) are being covered by existing programs but is of limited use to the parks because of scale.

USGS (A) – stream channel over time – they have methods to look back 400 years
- elevation data and remote sensing to look at topography over 100 years
- Shallow coring to determine site history and sediments, measured annually and episodically
- NAWQA (C,D,E,F)
- sampling for air deposition (C, D, F)
- Lithogeochemistry mapping
- USGS, data available through USGS BRD Partner?

EPA
- EMAP (all)
- MAIA Stream Study (E, F)

States – (A,B, C, D, E, H, I, J,)

USCE, NRCS, other states wetland assessment models (A)

Penn State (see EPA/MAIA) shoreline inundation models, they have an additional grant ask them to study our area, also Charlie Roman at University of Rhode Island (B) www.climatescience.gov for mapping, modeling, monitoring, funding (B)

Old water wells in parks can be used to measure groundwater (E, F)

Additional Discussion

Other discussion points included:
(1) The difference between screening and monitoring and the potential to treat the first year of monitoring as a screening to determine appropriate long-term monitoring sites and the frequency of data collection needed to monitor various aspects of quality or lack thereof. The screening approach is a probability-based design.
(2) Threats to resources may be outside the parks and then correlation or causation needs to be investigated, but such a research project does not fall under this program.
(3) Site Selection criteria discussed include:

- 1st to 3rd order, perennial streams
- Classified by land-use or some other regional scale assessment, with random selection within each class
- Sites should include high quality streams (state designation or some NCR definition?) (frequency of sampling here would be lower)
- Sensitive populations (such as trout) could be used to define high quality
- Areas known to be impaired or where stressors are identified
- The more sensitive or stressed sites should be sampled more frequently
- From a park management perspective the "fair" sites will show improvement, meeting GPRA goals.
- Randomized or fixed sites selection? Most parks have two or three streams, except GWMP and C&O which have many.
- Of the sites which meet these requirements, 75 meter reaches will be sampled. Possibly the entire stream in some areas such as C&O canal. Selection of these reaches has yet to be established but could be random, or best professional judgement.
- Establish sentinel / reference (lower frequency monitoring)

Summary

Monitoring of water related Vital Signs can be combined under the following methods:
- Physical Habitat Index (Changes in topography, sediment loading and deposition, shoreline change, wetland extent and condition; Inundation of wetlands, erosion and sedimentation processes, and Physical Habitat)
- Hach Test Kits (Nutrients, Specialized Water Quality Parameters, Groundwater Chemistry)
- Groundwater Monitoring Wells (Groundwater level, sample collection for Groundwater Chemistry)
- Hydrolab Sensors (Core Water Parameters)
- MBSS-based Biological Indices (Fish and Macroinvertebrates).

<all together>

Wrap-up

1. Participants were asked to comment on the SAC process

- Continued need to integrate vital signs, especially with existing programs.

- Identify vital signs and still consider them for monitoring later, as opportunities arise, even if they do not represent the highest priority at the moment.

- Prioritize vital signs based on common threats.

- Consider sampling and collecting information even if there is no immediate need to analyze data.

2. Participants were asked to provide feedback on the I & M Newsletters (printed and online versions).

- Most had seen it, but not everyone directly received the printed version.

Adjourn

Appendix 1. Proposed Remote Sensing Vital Signs

Vital Sign	Monitoring Goals	Monitoring Objectives	Workgroup	Threat
Ratio of edge to interior, patch size, distribution, composition (veg vs urban), proximity (of patches to each other and to development or other fragmenting feature) (see over use)	Determine the ratio of edge to interior patch size	Obtain fragmentation (at various scales) indices using annual satellite imagery and aerial photography every 5 years. Develop and maintain georeferenced GIS database of fragmenting features with in each park (road, trails, etc.).	Vegetation	Fragmentation
Amount of forest interior habitat; size / edge index; distance between habitat	Monitor quantity of forest interior habitat	Monitor the number of forest interior patches of greater than or equal to 5000 ha within the Lower Chesapeake Bay Watershed for 5 years.	Landscape	Any development, habitat fragmentation / amount of edge (forest interior habitat)
Connectivity of habitat of interest; # of breaks in corridor	Monitor the connectivity of green and blue space	Monitor the percent of protected, number of patches, and contiguity of green and blue space within the Lower Chesapeake Bay Watershed for 5 years.	Landscape	Any development, land use practices (corridors)

1) Forest habitat types;2) Bird Community Index	Monitor forest habitat types	Monitor the % cover of forest habitat types within the Lower Chesapeake Bay Watershed for 5 years.	Landscape	Land use, land use practices (total forest habitat)
Inundation of wetlands, erosion and sedimentation processes.	Use mapping or survey methods to track shoreline change and depositional patterns.	1	Geology	Shoreline change
Percent loss of native vegetation; percent disturbance/loss of topsoil due to development (see external development)	Identify loss of native vegetation.	Maintain GIS layer of internal development and maintained/ landscaped areas (update annually). Characterize vegetation lost (gained) disturbed as a result (see fragmentation).	Vegetation	Internal development (first draft of objectives by Chip, Brent, and L.K.)
Bird Community Index	Monitor quality of forest interior habitat	Monitor status and trends of forest interior birds to determine quality of forest interior habitat within the Lower Chesapeake Bay Watershed for 5 years.	Landscape	Any development, habitat fragmentation / amount of edge (forest interior habitat)
Vegetation composition change as a function of distance (see fragmentation)	Determine vegetation composition change as a function of distance from development.	Maintain GIS layer of (near) external development (update annually). Identify internal areas likely to be affected by changes in hydrology and weed sources. Monitor vegetation composition changes. (See fragmentation.)	Vegetation	Internal Development (first draft of objectives by Chip Scott, Brent Steury, and L.K. Thomas)
Change in % of any species specific habitat; Bird Community Index; percentage of impervious surface	Monitor species specific natural habitat	Monitor percentage and distribution of the targeted species suitable habitat within the Lower Chesapeake Bay Watershed for 5 years.	Landscape	Land use, land use practices (species specific natural habitats)
Acres defoliated, egg mass density; vegetation composition under defoliated area; mean egg mass size	Determine acres defoliated by gypsy moths and egg mass density. Monitor vegetation composition under defoliated area. Determine the area of forest tree canopy defoliated that is attributable to gypsy moth. Measure the area and distribution and treatment type of gypsy moth treatment blocks.	Estimate the number of egg masses (and mean size) in vegetation types susceptible to gypsy moth defoliation.	Vegetation	Gypsy Moth (first draft of objectives by Chris Lea and Drew Banasik)
Changes in topography, sediment loading and deposition, shoreline change, wetland extent and condition.	Use survey and analysis methods to evaluate changes in topography, sediment loading, and flow rates.	(1) Measure loss of soil, growth of gulleys, changes in streambanks…. (2) Track sedimentation history, effects, and impacts (including streams and ponds, hillslopes and gulleys).	Geology	Erosion and sedimentation
RTE Communities			RTE	

RTE Species	Monitor priority sites.		RTE	
Numerous indicators can be incorporated into the viewshed analysis program	Monitor the viewshed	Monitor the number of physical structures viewable from park units and other green space within the Lower Chesapeake Bay Watershed for 5 years.	Landscape	
Number of social trail extent and condition of existing trails; number of visitors/year	Determine number of social trails.	Estimate the area (length and width) of social trail impacts within the highest visitor use areas at the 11 parks every three years.	Vegetation	

Appendix 2. Proposed Vegetation Monitoring Vital Signs

Vital Sign	Monitoring Goals	Monitoring Objectives	Workgroup	Threat
Ratio of exotics to natives, species richness, percent cover of exotics and natives, density/stem counts	Determine the ration of native to exotics	Estimate the species cover in 11 park units yearly until 2008 in 1% of naturally established vegetative areas	Vegetation	Non-native plants
Percent loss of native vegetation; percent disturbance/loss of topsoil due to development (see external development)	Identify loss of native vegetation.	Maintain GIS layer of internal development and maintained/ landscaped areas (update annually). Characterize vegetation lost (gained) disturbed as a result (see fragmentation).	Vegetation	Internal development (first draft of objectives by Chip, Brent, and L.K.)
Bird Community Index	Monitor quality of forest interior habitat	Monitor status and trends of forest interior birds to determine quality of forest interior habitat within the Lower Chesapeake Bay Watershed for 5 years.	Landscape	Any development, habitat fragmentation / amount of edge (forest interior habitat)
Vegetation composition change as a function of distance (see fragmentation)	Determine vegetation composition change as a function of distance from development.	Maintain GIS layer of (near) external development (update annually). Identify internal areas likely to be affected by changes in hydrology and weed sources. Monitor vegetation composition changes. (See fragmentation.)	Vegetation	Internal Development (first draft of objectives by Chip Scott, Brent Steury, and L.K. Thomas)
Change in % of any species specific habitat; Bird Community Index; percentage of impervious surface	Monitor species specific natural habitat	Monitor percentage and distribution of the targeted species suitable habitat within the Lower Chesapeake Bay Watershed for 5 years.	Landscape	Land use, land use practices (species specific natural habitats)
1) Forest habitat types;2) Bird Community Index	Monitor forest habitat types	Monitor the % cover of forest habitat types within the Lower Chesapeake Bay Watershed for 5 years.	Landscape	Land use, land use practices (total forest habitat)

Seedling regeneration distribution of species preferred by deer vs. species not preferred by deer; Numbers of seedlings and saplings by height class; Percent of area with adequate regeneration by size class distribution	Identify impact of deer on forest regeneration	Show relationship between seedling regeneration and deer population size	Vegetation	White-tailed deer
Number of downed trees and exposed roots; flood plain species composition.	Determine number of downed trees and exposed roots.	Determine the number of fallen trees and exposed roots annually on vertical bank slopes and the change of species composition every 5 years in floodplain habitat.	Vegetation	Stream bank and channel erosion (first draft of objectives by Sue Salmons and Mikaila Milton)
Invasive Invertebrate Species	Prevent invasion of invertebrate species	Identify potential invertebrate species. Implement monitoring to identify potential invertebrates in order to detect and prevent spread in a timely manner.	Invertebrate	
Monitoring (ambient) vegetation	Monitor ambient ozone concentrations and trends that affect human health and terrestrial ecosystems	Communicate risk of ozone to human health for employees and the public and assess impacts to terrestrial ecosystems	Air	Ozone
RTE Species	Monitor priority sites.		RTE	
RTE Communities			RTE	
Number of lichens/plot; species richness, composition, density of lichens/plot/ ozone sensitive species/leaf damage/ thickness of algae layer in lichen over time	Determine number of lichens per plot and species composition. Also determine leaf damage to ozone sensitive species and thickness of algae layers in lichens.	Establish long-term monitoring plot for lichens at a range of sites. Monitor lichen cover and composition and correlate with regional O3, NxOx and SxOx levels. Monitor every 5 years to establish trends. Monitor O3 damage to vascular plants.	Vegetation	Air pollution (first draft of objectives by Dean Walter and Doug Samson)

Appendix 3. Proposed Water Monitoring Vital Signs

Vital Sign	Monitoring Goals	Monitoring Objectives	Workgroup	Threat
Changes in topography, sediment loading and deposition, shoreline change, wetland extent and condition.	Use survey and analysis methods to evaluate changes in topography, sediment loading, and flow rates.	(1) Measure loss of soil, growth of gulleys, changes in streambanks…. (2) Track sedimentation history, effects, and impacts (including streams and ponds, hillslopes and gulleys).	Geology	Erosion and sedimentation
Nutrients (with Hach test kits)			Water	

Specialized Water Quality Parameters (USGS's NAWQA - specifics depend on park needs)			Water	
Core Water Parameters (temperature, DO, pH, conductivity, flow, acid neutralizing capacity	mandatory			
Physical habitat	mandatory			
Fish IBI	mandatory			
Macro Invertebrates	mandatory			
Groundwater Level (USGS protocol)	Measure groundwater level changes over time.	Evaluate change and cause of groundwater changes.	Water	
Changes in soil and ground water chemistry.	Use an input/output approach to understand nutrient and contaminant cycling in the ecosystem.	(1) Measuring nutrient inputs from sources pertinant to each park unit. (2) Measuring contaminant inputs from sources pertinant to each park unit. (3) Tie information from numbers 1 and 2 to the hydrologic cycle, flood history, flood effects, and flood impacts.	Geology	Nutrient and chemical contamination
Inundation of wetlands, erosion and sedimentation processes.	Use mapping or survey methods to track shoreline change and depositional patterns.	1	Geology	Shoreline change